WOODWARD

SYNCONpanel
Transportable Remote Synchronizing Panel

Brief Manual
Version 1.1xx

Manual 37187A

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.

CAUTION

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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Important definitions

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.

NOTE

Provides other helpful information that does not fall under the warning or caution categories.

Revision History

Rev.	Date	Editor	Changes
NEW	05-10-04	TP	Release
A	06-04-06	TP	Note for current measuring added

Contents

Illustrations and Tables

Illustrations

Tables

Chapter 1.
General Information

Related Documents

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This brief manual can only be used together with the complete documentation set of the GCP-31/RPQ+SC08.

Type	English	German
GCP-31/32 Series		
GCP-31/32 - Installation	37239	GR37239
GCP-31/32 - Configuration	37278	GR37278
GCP-31/32 - Function/Operation	37238	GR37238
GCP-31/32 - Application	37240	GR37240
Additional Manuals		
LeoPC1 - Manual	37146	GR37146
PC program for visualization, configuration, remote control, data logging, language upload, alarm and user management and management of the event recorder. This manual describes the use of the program.		
LeoPC1 - Manual	37164	GR37164
PC program for visualization, configuration, remote control, data logging, language upload, alarm and user management and management of the event recorder. This manual describes the programming of the program.		

Table 1-1: Manual - Overview

Intended Use This control is intended to be operated according to the guidelines described in this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

NOTE

This manual has been developed for a control fitted with all available options. Inputs/outputs, functions, configuration screens and other details described, which do not exist on your control may be ignored.

The present manual has been prepared to enable the installation and commissioning of the control. Due to the large variety of parameter settings, it is not possible to cover every combination. The manual is therefore only a guide. In case of incorrect entries or a total loss of functions, the default settings can be taken from the list of parameters located in the appendix of the Configuration manual.

NOTE

When using the SYNCONpanel together with the GCP-31/RPQ+SC08, it is not possible to configure and control the GCP-31/RPQ+SC08 remotely using LeoPC1 via CAN connection.

Introduction
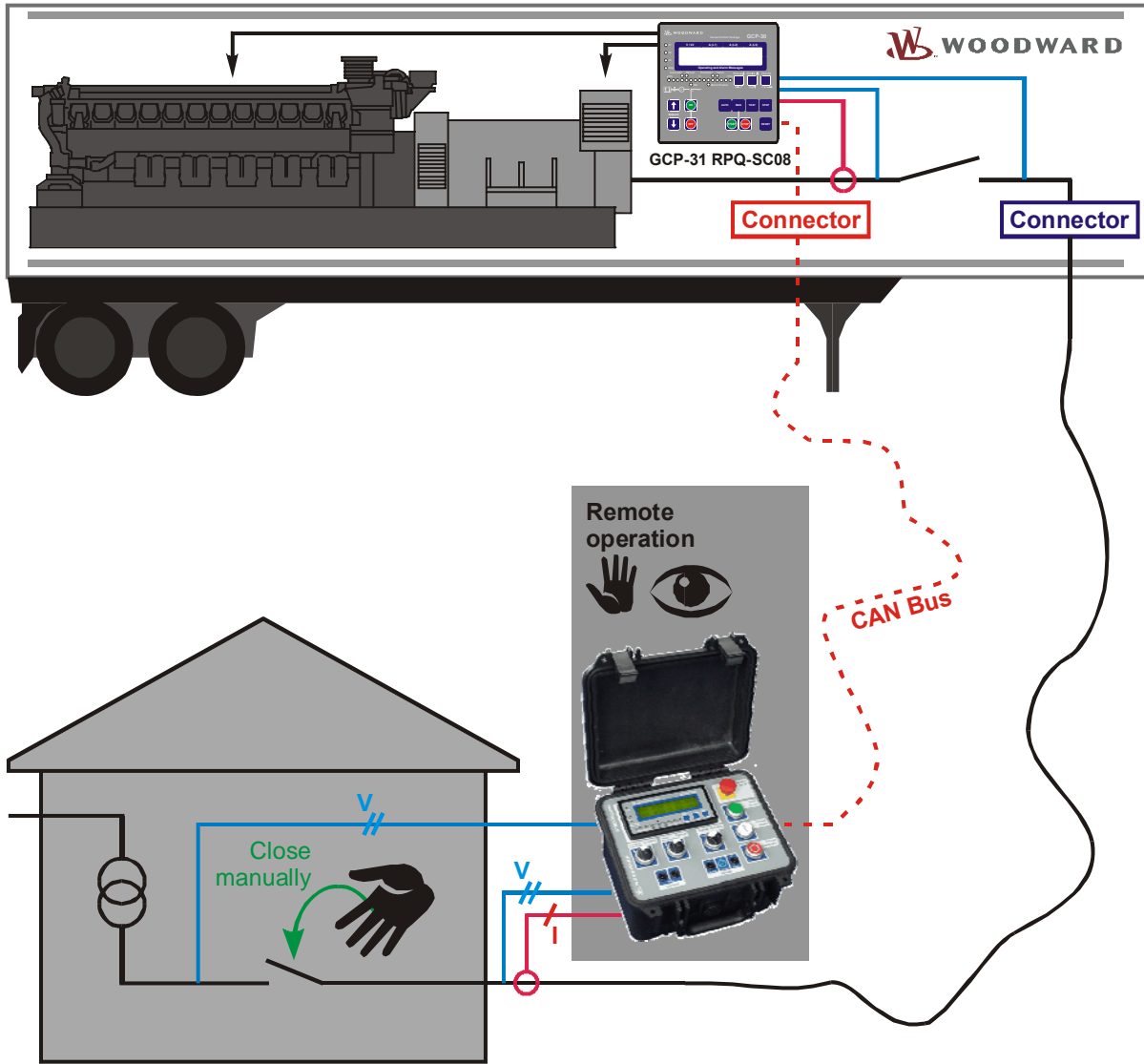
Figure 1-2: Typical application of a mobile system

Mobile systems are defined as a generator set with a generator circuit breaker (GCB), which can easily be installed near a feeder or transformer, and operate as follows:

- In parallel with mains operation to support the utility [peak load operation]
- In automatic mains failure mode to operate in case of a mains failure [emergency operation]
- Independent operation from the utility [isolated operation]
- With a behavior which allows to open and close the interchange point to the utility [transfer operation]

The GCP-31/RPQ+SC08 supports these modes, which are required for a mobile system.
For maintenance on a interchange point to mains (high voltage transformer or wiring replacement), the GCP-31/RPQ+SC08 requires the connection to the SYNCON Panel which helps the operator to overtake load from mains to the mobile system and back. Therefore one or several mobile container(s) can be used.
The GCP-31/RPQ+SC08 offers a special discrete input for the transfer operation and emergency operation. Additionally, it offers a special discrete input for connecting an phase rotation relay, which is required for the busbar connection. The other modes are realized through special handling of the given control inputs.

Chapter 2.
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1.   Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2.   Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

3.   Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control, modules, and work area as much as possible.

4.   **Opening the control cover may void the unit warranty.**
        Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

   - Ensure that the device is completely voltage-free (all connectors have to be disconnected).

   - Do not touch any part of the PCB except the edges.

   - Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.

   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

⚠ **CAUTION**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Chapter 3.
Installation

Wiring Schematic Mobile System
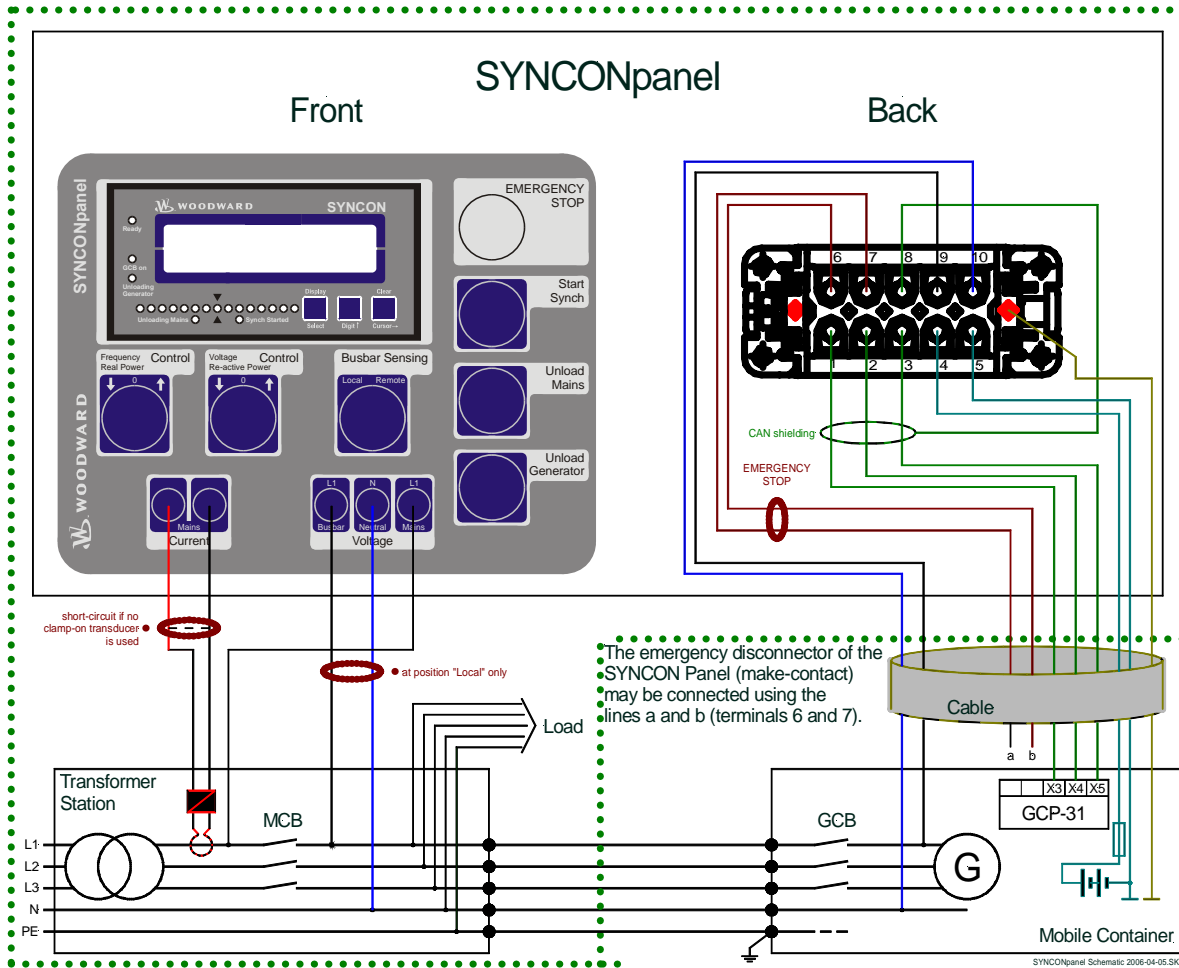
Figure 3-1: Wiring schematic mobile system

Discrete Inputs

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To use the GCP-31/RPQ+SC08 for a mobile system like described, discrete inputs are required.

⚠ CAUTION

Please note that the maximum voltages, which may be applied at the discrete inputs are defined as follows. Voltages higher than those specified destroy the hardware!

Maximum input range: +/-4 to 40 Vdc.

Terminal	Associated common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
3		Automatic 1	2.5 mm²
5	7	Automatic 2	2.5 mm²
53		Enable MCB (mains circuit breaker)	2.5 mm²
4		Reply: GCB is open	2.5 mm²
54	7	Reply: Mains power circuit breaker is open or mains parallel status (in items with 1 CB)	2.5 mm²

Table 3-1: Terminal assignment - discrete inputs

To monitor a phase rotation relay, the alarm input [D03] must be used.
If it is required to block an automatic mains failure start, the discrete input [D11] must be programmed to "Inhibit emergency run".

Terminal	Associated common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
36	33	Discrete input [D03] "Phase rotation check O.K.": This control input is evaluated if the busbar is energized. In case of a failure, the message "Phase sequence" is displayed and closing the circuit breakers is blocked. If the busbar phase rotation shall not be monitored, this input must be energized permanently.	2.5 mm²
68	60	Discrete input [D11] - Alarm input or - Inhibit emergency run	2.5 mm²

Table 3-2: Terminal assignment - discrete inputs

Chapter 4.
Mobile System Modes

The operating modes of the Rental Package GCP-31/RPQ+SC08 are usually selected via an external selector switch and the digital inputs. A typical connection of the selector switch and a description of the operating modes belonging to it may be found in the following.
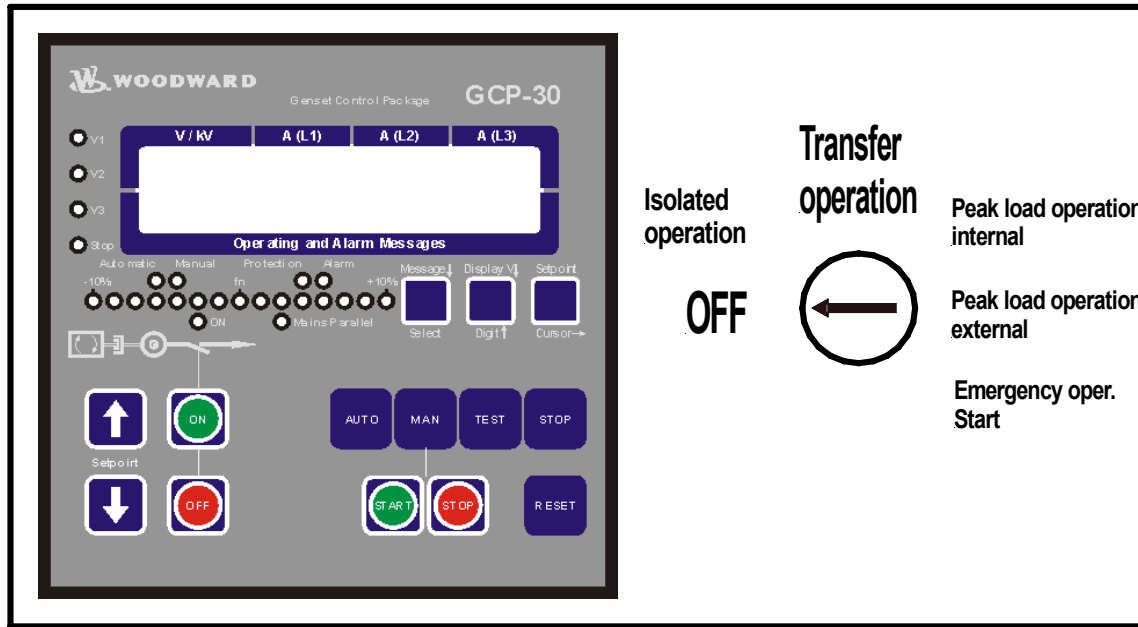
For this, the signals are to be connected as follows:

Signals to be connected / Operating mode	Terminal 54 Reply MCB OFF	Terminal 126 Mobile Systems	Terminal 53 Enable MCB	Terminal 68 Inhibit emergency run **	Terminal 3 Automatic 1	Terminal 5 Automatic 2
OFF (de-energized)	irrelevant	irrelevant	irrelevant	irrelevant	irrelevant	irrelevant
Isolated operation	1	0	0	1	remote control	0
Transfer operation	1	1	0 (Syncon Panel) remote control *	1	remote control	irrelevant
Peak load operation internal	0	0	1	1	remote control	0
Peak load operation external	0	0	1	1	0	remote control
Emergency operation Start	reply must be connected	0	1	0	0	0

*) If a synchronization between mains and generator busbar voltage is to be performed without SYNCON Panel, this DI must initiate the synchronization.

**) If no emergency power operation is required, the parameter "Emergency run" may be disabled. This allows to use terminal 68 as free alarm input.

Switch Position OFF

The GCP will be de-energized in this operating mode. No actions are initiated by the unit anymore. If you switch to position OFF while the genset is running, the GCB opens and the genset stops immediately (it is assumed that this is provided by the customer).

Switch Position Isolated Operation

The GCP operating modes are enabled:

STOP: Genset stops with cool down or remains stopped. If necessary, the load will be taken off of the genset and the GCB will be opened.

MANUAL: Genset may be started and stopped manually. The generator breaker may be closed and opened using the manual keys. Frequency and voltage are controlled isochronous.

AUTOMATIC: The genset will be started and the GCB will be closed if remote control has been activated.

TEST: The genset will be started. The GCB may be closed and opened using the MANUAL keys.

The set points for frequency and voltage may either be modified using the arrow keys at the unit or via the digital inputs.

Switch Position Transfer Operation

(Function enable station and return to the mains)
The GCP operating modes may be freely available or fixed to **MANUAL** operating mode. The parameter "Interchange mode in Manual", which is responsible for this, is in the parameter group Automatic (refer to Configuration Manual 37278).

The following is valid in general:
Only the GCB will be synchronized. It is not possible to connect to a de-energized generator busbar.
If the GCB is closed, the generator monitoring is loaded with the trigger times mains monitoring, the phase shift monitoring is not active.
The automatic mains connection detection*) will be activated.
If no mains connection is detected, a frequency and voltage control with droop will be performed.
If a mains connection is detected, real and reactive power control will be performed.
A phase relation zero control with the mains may be restarted via the DI at terminal 53 (Enable MCB) or the SYNCON Panel. This will be disabled automatically if a mains connection is detected.
It is principally possible to open the GCB with the Operation mode STOP key for security reasons.

*) *Automatic mains connection detection:*
The GCP detects automatically via phase L1 whether the generator is in parallel with the mains.
If the phase relation between mains and generator busbar is recognized as "fixed", the message "Mains connected" will be displayed. This is the case if the angle of L1 between mains and busbar remains below a certain angle limit for a certain time. Angle and time may be configured with the parameter "Detection mains coupling" under phase controller within the parameter group breaker (refer to Configuration Manual 37278).
This automatic detection is used to decide whether real and reactive power or frequency and voltage control is to be performed.

The following is valid for free operating mode selection at the GCP:

STOP: Genset stops with cool down or remains stopped. If necessary, the load will be taken off of the genset and the GCB will be opened.
MANUAL: Genset may be started and stopped manually. The generator breaker may be closed and opened using the manual keys.
AUTOMATIC: The genset will be started and the GCB will be closed if remote control has been activated.
TEST: Not possible; if transfer operation is selected during TEST operation, an automatic change to MANUAL operating mode will be performed.

The set points for frequency and voltage or real power and power factor may either be modified using the arrow keys at the unit, via the digital inputs, or using the SYNCON Panel.
Only the set points, the control of which is currently active, may be modified via the Dis.

Switch Position Peak Load Operation "Internal"

The GCP operating modes are enabled:

STOP: Genset stops with cool down or remains stopped. If necessary, the load will be taken off of the genset and the GCB will be opened.
MANUAL: Genset may be started and stopped manually.
                    The generator breaker may be closed and opened using the manual keys. After closing the GCB, real and reactive power are controlled.
AUTOMATIC: The genset will be started and the GCB will be synchronized if remote control has been activated. After closing the GCB, real and reactive power are controlled. The set real power 1 and the power factor are stored **"internally"**.
TEST: The genset will be started. The generator breaker may be closed and opened using the manual keys.

The set points for real power and power factor may either be modified using the arrow keys at the unit or via the digital inputs.

Switch Position Peak Load Operation "External"

The functions correspond with the switch position peak load operation "internal" except the difference that the real power set point is controlled by a 0/4 to 20mA signal or transmitted via an interface.

Switch Position Emergency Power Start

The GCP operating modes are enabled:

STOP:	Genset stops with cool down or remains stopped. If necessary, the load will be taken off of the genset and the GCB will be opened.
MANUAL:	Genset may be started and stopped manually. The generator breaker may be closed and opened using the manual keys. No automatic change-over to emergency power is activated.
AUTOMATIC:	If mains fail (measurement via terminals 50, 51, 52) the genset will be started, the MCB will be opened and the GCB will be closed. If mains return, the MCB will be synchronized back after the mains settling time has expired. Then the load will be taken off of the genset and the genset will be stopped.
TEST:	The genset will be started. The generator breaker may be closed and opened using the manual keys. An automatic change-over to emergency power will be performed if necessary.

The set points for frequency and voltage may either be modified using the arrow keys at the unit or via the digital inputs.

NOTE

It is required for the emergency power start function that the MCB reply is connected. The start and stop commands from the GCP must also be wired to the MCB to enable an automatic change-over.

Chapter 5.
Display and Operating Elements

SYNCON Unit

The pressure-sensitive membrane of the front panel consists of a plastic coating. All keys have been designed as touch-sensitive membrane switch elements. The display is a LC-display, consisting of 2 rows of 16 characters each, with indirect green lighting. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the right side of the control.
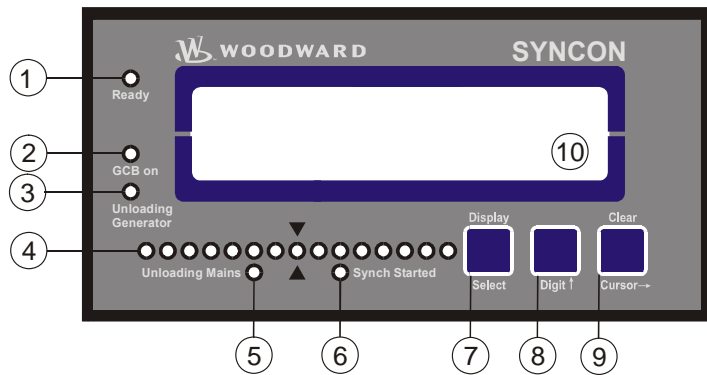
Figure 5-1: SYNCON unit front panel

Brief Description of LEDs and Push Buttons

LEDs

No	Description	Function
1	Ready	Ready for operation
2	GCB on	Reply: GCB is closed
3	Unloading Generator	Generator is being unloaded
4	Synchroscope	Display of phase position
5	Unloading Mains	Mains are being unloaded
6	Synch Started	Synchronization has been started

Buttons

No	Description	Function
7	Display↓	Scroll display
7	Select	Confirm selection
8	Digit↑	Increase digit
9	Clear	No function
9	Cursor→	Shift input position one digit to the right

Others

No	Description	Function
10	LC-Display	LC-Display

LEDs

1	**Ready** Color: green	**Ready for operation**

This LED indicates that the unit is ready for operation if the following conditions are fulfilled:
- Terminal 126 of the GCP must be energized
- GCB must be closed (reply "GCB is open" must be de-energized)
- CAN bus connection between SYNCONpanel and GCP must be active
- The "Phase control" parameter of the GCP must be configured ON

2	**GCB on** Color: green	**Power circuit breaker open/closed**

The "Gen CB - ON" LED indicates if the response of the power circuit breaker is open or closed. The "Gen CB - ON" LED illuminates if the discrete input "Reply: CB is open" of the GCP is not energized and will turn off as soon as the discrete input is energized.

3	**Unloading Generator** Color: green	**Unloading generator**

This LED indicates that the generator unloading function is active. The LED extinguishes if the GCB is open.

4	**LED-row:** too fast→ Color: red/yellow/green	**Phase position / Synchroscope**

The row of LEDs indicates the current phase relationship between the two voltages indicated in the display. The green LED in the center of the 15 LEDs indicates that the measured phase angle between the voltage systems is +/- 12 ° electrical.

The synchroscope LEDs can move in two directions:

left → right . If the LEDs illuminate from left to right, the generator (variable system) frequency is higher than the mains or reference voltage system (i.e. the generator or the variable system has a frequency of 60.5hz and the mains is 60hz).

right → left . If the LEDs illuminate from right to left, the generator (variable system) frequency is lower than the mains or reference voltage system (i.e. the generator respectively the variable system has a frequency of 59.5hz and the mains is 60hz).

5	**Unloading Mains** Color: green	**Unloading mains**

This LED indicates that the mains unloading function is active. The LED extinguishes if the MCB is open (mains disconnected).

6	**Synch Started** Color: green	**Synchronization started**

This LED indicates that the synchronization of the MCB with phase matching is active.

Push Buttons

Configuration may be performed by manually inputting the desired set points utilizing the pushbuttons and the LC display. In order to facilitate configuring the parameters, the push buttons have been enabled with an AUTOROLL function. This permits the user to advance to the next setting, configuration screen, digit, and/or cursor position more rapidly by pressing and holding the corresponding pushbutton.

| 7 | **Display / Select** | **Display / Select** |

Automatic mode: <u>Display</u> - By pressing this button, the user may navigate through the displayed measured parameters and alarm messages.

Configuration: <u>Select</u> - Advances the LC display to the next configuration screen. If any values in a configuration screen have been modified with the "Digit$\uparrow$" or "Cursor$\rightarrow$", then the "Select" button must be pressed to save the new setting. By pressing this push-button again, the user causes the system to display the next configuration screen.

| 8 | **Digit$\uparrow$** | **Digit $\uparrow$** |

Automatic mode: no function

Configuration: <u>Digit$\uparrow$</u> - Numerical values over the cursor are increased by one digit. The increase is restricted by the admissible limits (refer to the list of parameters included in the appendix). If the maximum admissible number is reached, the number automatically returns to the lowest admissible number.

| 9 | **Clear / Cursor $\rightarrow$** | **Clear / Cursor$\rightarrow$** |

Automatic mode: <u>Clear</u> - no function

Configuration: <u>Cursor$\rightarrow$</u> - This button moves the cursor one position from left to right. When the cursor is under the last digit that may be changed, it may be moved to the first number of the value by pressing the "Cursor$\rightarrow$" button again.

LC Display

| 10 | **LC-Display** | **LC-Display** |

The two-line LC display outputs corresponding text messages and values depending on the mode that the SYNCON is operating. In the configuration mode, the monitoring parameters may be changed. When the SYNCON is in the automatic mode, the measured values are displayed.

Display Monitoring in Automatic Mode: Double Voltage / Frequency Display

```
MN: 000 V 00.0Hz
GN: 000 V 00.0Hz
```

Double voltage and double frequency displays, mains and generator values

The mains/generator voltage and frequency are displayed in this screen. The phase angle between the mains and generator voltage is displayed by the synchroscope (LED strip).

MN....Mains voltage and frequency
GN.....Generator voltage and frequency

```
-.--    000kvar
 000 A   000kW
```

Mains measuring value displays

The following mains measuring values are displayed:
- Power factor
- Reactive power
- Current
- Active power

Note: The measuring values are only displayed if the clamp-on transducer is connected.

SYNCONpanel

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The SYNCONpanel consists of the SYNCON unit described under SYNCON Unit on page 14 and various control switches and buttons as well as measuring inputs.

Figure 5-2: SYNCONpanel front

Push Buttons

The following push buttons are utilized to remote control the synchronization process on the SYNCONpanel.

11	EMERGENCY STOP	**Emergency Stop**
		The emergency stop button generates an alarm in the GCP that opens the GCB and stops the engine immediately.
		Note: For safety reasons, it is absolutely necessary that the connection with the GCP and the configuration of the GCP's discrete input are correct.
12	Start Synch	**Start synchronization**
		This push button starts the synchronization sequence with phase matching. If the two systems are synchronous, the lamp in the push button illuminates.
13	Unload mains	**Unload mains**
		This push button initiates the mains unloading sequence. The load will be ramped from the mains to the generator.
		Note: The unload mains push button can only be used if the SYNCONpanel is measuring the current.
14	Unload generator	**Unload generator**
		This button initiates the generator unloading sequence. The generator performs the unloading function and opens the GCB.

Selector Switches

15	Frequency / Real Power Control	**Frequency / Real Power Control**
		↓ **(lower)** ....Decreases the frequency / real power control set point
		↑ **(raise)** .....Increases the frequency / real power control set point

16	Voltage / Reactive Power Control	**Voltage / Reactive Power Control**
		↓ **(lower)** ....Decreases the voltage / reactive power control set point
		↑ **(raise)** .....Increases the voltage / reactive power control set point

17	Busbar Sensing	**Busbar sensing selection**
		Local..........The busbar voltage is measured via the voltage measuring inputs on the front of the SYNCONpanel.
		Remote ......The busbar voltage is measured via the industrial plug-in connector. The measuring inputs on the front of the SYNCONpanel (Busbar L1 and Neutral N) are disconnected.

⚠ **CAUTION**

Observe the safety instructions in the SYNCONpanel cover!

Measuring Inputs

18	Current	**Current measuring input**
		The clamp-on transducer must be connected here.

ⓘ **NOTE**

If no clamp-on transducer is used, the current measuring input must be closed with a short-circuiting termination to ensure a proper operation of the unit without a clamp-on transducer.

19	Voltage	**Voltage measuring input**
		The voltage measuring lines must be connected here.

Chapter 6.
Configuration

NOTE

When using the SYNCONpanel together with the GCP-31/RPQ+SC08, it is not possible to configure and control the GCP-31/RPQ+SC08 remotely using LeoPC1 via CAN connection. It is required to configure the unit via LeoPC1 and a DPC connection.

CAUTION

Please note that configuration only should be done in a standstill of the system.

GCP Configuration

Controller Configuration

Frequency Controller

In case of transfer operation mode, the unit controls frequency and voltage with droop behavior.
For the transfer operation mode, a droop characteristic for the frequency controller is required, otherwise the generator set would not be able to maintain a stable active power being in parallel with the mains.

```
Freq.controller
droop      02.0%
```

Frequency controller droop	**0 to 20 %**

The internally set value for frequency will be reduced by the configured value, when the nominal power of the generator is reached.

Setpoint Frequency-Control
Droop (static curve)
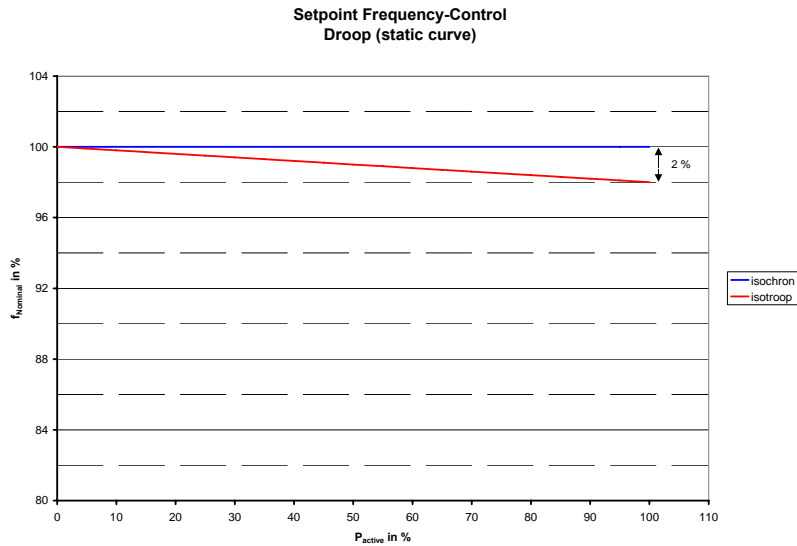
Figure 6-1: Frequency controller droop characteristic

Voltage Controller

In case of transfer operation mode, the unit controls frequency and voltage with droop behavior.

For the transfer operation mode, a droop characteristic for the voltage controller is required, otherwise the generator set would not be able to maintain a stable reactive power being in parallel with the mains.

```
Volt.controller
droop      02.0%
```

Frequency controller droop   **0 to 20 %**

The internally set value for voltage will be reduced by the configured value, when the maximum reactive power of the generator is reached.

Example: In case of a 200 kW engine power, the reactive power will be 200 kvar as base value.
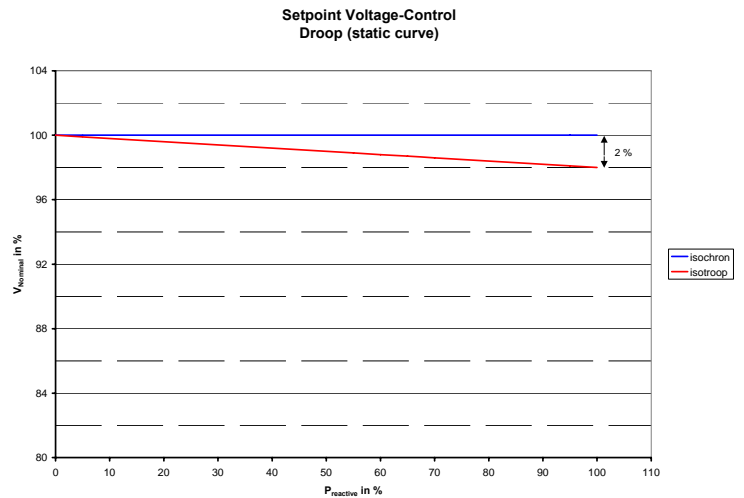
Figure 6-2: Voltage controller droop characteristic

Power Factor Controller

In case of transfer and mains parallel operation mode, the power factor controller is required.

```
Pow.fact.contr.
            ON
```

Power factor controller   **ON / OFF**

ON................In a mains parallel operation automatic control of the power factor is carried out. If there are excessively low currents (secondary current less than 5 % I_{rated}) the power factor cannot be accurately measured. In order to prevent power swings, the controller automatically locks the power factor at a set value. The subsequent screens of this function are displayed.

OFF..............Power factor control is not performed, and the subsequent screens of this function are not displayed.

Automatic Mode Configuration

```
Power On Mode:
         STOP
```

Start in mode: **STOP, MANUAL, AUTOMATIC, as before**

STOP............The unit is in STOP operating mode after applying battery voltage.
MANUAL ....The unit is in MANUAL operating mode after applying battery voltage.
AUTOMATIC The unit is in AUTOMATIC operating mode after applying battery voltage.
as before.......The unit is in the same operating mode after applying battery voltage as it was before disconnecting the battery voltage.
Note: The operating mode may be changed with the terminals 126, 127, and 128.

```
Interchange Mode
in Manual     ON
```

Interchange mode in manual   **ON/OFF**

OFF ....Interchange mode (enabled by the DI at terminal 126) may also be performed in AUTOMATIC operating mode.
ON ....Interchange mode (enabled by the DI at terminal 126) may **only** be performed in AUTOMATIC operating mode.

Breaker Configuration

```
Breaker logic:
--------PARALLEL
```

Breaker logic   **see below**

The control automatically controls the two breakers (MCB and GCB). Up to five (5) breaker logic modes may be selected. These are: EXTERNAL, PARALLEL, OPEN TRANSIT, CLOSED TRANSIT and INTERCHANGE.

For mobile systems the parallel logic is required.

NOTE

In case of transfer and mains parallel operation mode, phase matching is required. The SYNCON Panel will not operate, if this parameter is disabled.

```
Phase matching
             ON
```

Phase matching   **ON/OFF**

ON ....Synchronization will be performed with phase matching.
OFF ....Synchronization will be performed with slightly positive slip.

```
Phase matching
gain         00
```

Phase matching gain   **1 to 36**

The phase matching effect on the frequency control may be affected with this gain factor.

```
Phase matching
df start  00,0Hz
```

Phase matching df start   **0,02 to 0,25 Hz**

Phase matching will only be enabled if the frequency difference of the voltages to be synchronized is below the value configured here.

```
Detection Mains
connected <  00°
```

Mains connection detection (angle)   **1 to 15°**

If the phase angle between busbar and mains is below the angle configured here for at least the time configured in the next parameter, the unit detects the connection between busbar and mains and indicates this with the message "Mains connected".

`Detection Mains` `conn. after 000s`	**Mains connection detection (time)**	**0 to 999 s**

If the phase angle between busbar and mains is below the angle configured above for at least the time configured here, the unit detects the connection between busbar and mains and indicates this with the message "Mains connected".

Discrete Input Configuration

For mobile systems with AMF mode, the following function is required.

`Emergency OFF` `by Ter.68    OFF`	**Prevent an emergency power operation via terminal 68**	**ON/OFF**

OFF..............This terminal is used as an alarm input.
ON................This terminal is used as control input.

- High signal   If this terminal utilizes a HIGH signal (energized), an emergency power operation is prevented or terminated. The unit operates as if "Emergency power" is disabled.
- Low signal   If this terminal utilizes a LOW signal (de-energized), the setting of "Emergency power" is taken over.

SYNCON Configuration

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The following parameters are available in the SYNCON unit.

`Current probe` `            1mV/A`	**Current probe output voltage**	**1mV/A / 10mV/A**

The output voltage of the current probe is configured here. The output voltage signal must be an AC signal. Refer to Technical Data on page 26 for specifications.

`Export power` `limitation =00kW`	**Export power limitation**	**0 to 99 kW**

This parameter is utilized to detect a miswired current probe. Mains import power must be indicated negative. If the mains power is indicated positive and the value is higher than the value configured here, the message "reverse power" is displayed.

`Synchron. Gen.` `df max =   0.00Hz`	**Maximum permissible differential frequency (positive slip)**	**0.02 to 0.49 Hz**

If the positive slip is higher than the value configured here, the lamp and buzzer for the synchronization are not active.

`Synchron. Gen.` `df min = -0.00Hz`	**Minimum permissible differential frequency (negative slip)**	**-0.00 to 0.49 Hz**

If the negative slip is higher than the value configured here, the lamp and buzzer for the synchronization are not active.

`Synchronization` `dV max =      00V`	**Maximum permissible differential voltage**	**1 to 60 V**

If the voltage difference between the two systems is higher than the value configured here, the lamp and buzzer for the synchronization are not active.

`Synchron. Gen.` `phimax <      00°`	**Maximum permissible differential angle**	**0 to 15 °**

If the phase angle between the two systems is below the value configured here for at least 1 second, the lamp and buzzer for the synchronization will indicate this.

Chapter 7.
Operation with the GCP-31/RPQ+SC08

Transfer Operation

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This mode is selected using the switch on the main control panel.

The operating mode on the GCP-31/RPQ+SC08 may be freely selected or fixed to MANUAL operating mode (depends on the setting of the parameter "Interchange Mode in Manual", refer to Automatic Mode Configuration on page 22).

Synchronizing to the Mains and Loading the Generator Set

Taking over a consumer load to the mobile system, which previously has been supplied by the mains.

1. Set up the mobile system near the place of power supply/network feeder.

2. Connect the mobile system to the consumer busbar.

3. Ensure that the phases L1, L2, and L3 are connected correctly and the phase rotation is correct.

4. Connect the SYNCONpanel to the container (mobile system)

5. Connect the voltage measuring cables and the clamp-on transducer. Check, whether the polarity of the clamp-on transducer is correct (import power must be indicated negative). When using the clamp-on transducer in the wrong way, a "reverse power" is indicated on the SYNCONpanel display.

6. Select the "Transfer operation" mode using the switch on the control panel of the container (mobile system). The GCP is automatically switching to MANUAL mode (depends on the setting of the parameter "Interchange Mode in Manual", refer to Automatic Mode Configuration on page 22). The MCB LED starts to flash.

7. Start the generator set by pressing the START button on the GCP.

8. After starting the engine successfully, the generator can be synchronized with the busbar by pressing the "GCB ON" button on the GCP. With the feedback of a closed GCB, the "Ready" LED at the SYNCONpanel should light up, otherwise the SYNCONpanel is not in operation.

9. While the mobile system is operating in parallel with the mains, the load can be ramped from the mains to the generator in several ways:
    - The set point buttons on the GCP
    - The discrete inputs at terminal 65 and 66 on the GCP
    - The frequency and voltage control switches of the SYNCONpanel
    - Automatically using the "Unload Mains" push button of the SYNCONpanel

NOTE

The "Unload Mains" push button can only be used if the SYNCONpanel is measuring the current.

Measurements of Amps, kW, power factor, volts and frequency are indicated on the SYNCONpanel display.

10. When the load has been transferred from mains to the generator set, the connection to mains can be opened manually at the interchange point. If the single phases have to be disconnected individually, the following sequence must be kept: L3 – L2 – L1.

11. Now the generator is running with load in an isolated operation, but with droop characteristic. To avoid this, the "Isolated operation" mode can be select on the control panel of the container (mobile system). The GCP continues the isolated operation in "isochronous mode", so the frequency and the voltage is stable independently from the load. The "MCB" LED extinguishes.

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Now the mobile system is feeding the load independently.

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Synchronizing the Consumer Load Back from Generator to Mains

1. If not already done, connect the SYNCONpanel with the container and use the flat bar clamps for voltage measuring. The clamp-on transducer is not required, but if the connection with the mains is expected to take longer, it is recommended to use a clamp-on transducer here as well (the correct polarity must be observed).

2. Bus sensing should be performed locally. Only if there is no other possibility, the bus sensing may be performed remotely. But this requires the correct connection of the Container at the busbar, phase rotation and phase angle must checked before.

NOTE
If remote bus sensing is being used, the voltage across the fuse or breaker must be checked to ensure it is synchronous with the indication of the SYNCONpanel.

3. The operating mode of the mobile system must be set to "Transfer operation" at the container switch gear board.

4. Start of the back synchronisation by pressing the "Start Synch" push button. The zero phase angle between the two voltage systems, which adjust themself automatically, will be additional indicated by an acoustical (buzzer) and optical signal (lamp in push button). The phase angle between busbar and mains can be monitored generally by the LED band (synchronoscope). The range for being "in phase" is to be configured in the SYNCON unit.

5. The operator observes the remote panel and restores the connection to the mains if the phases are synchronous. If the single phases have to be connected individually, the following sequence must be kept: L1 – L2 – L3.
   If a mains connection is detected by the GCP and the clamp-on transducer is connected to the mains for power measurement, it will be switched to mains unloading from the first connection with the mains. The "Synch Started" LED extinguishes and the "Unloading Mains" LED illuminates. Now, the other connections may be made while limiting the power flow between mains and busbar.
   If a mains connection is detected by the GCP and no clamp-on transducer is connected to the mains for power measurement, it will be switched to constant real power and reactive power measurement from the first connection with the mains. Now, the other connections may be made while limiting the power flow between mains and busbar.
   Zero-phase control with clamp-on transducer is preferred for power measurement if the connection with the mains is expected to take longer.

6. After re-establishing the connection with the mains, the GCB may be opened via the remote panel. Therefore, the generator active power will be unloaded before. The GCB will open as soon as the load on the generator has dropped below a set value.

7. The Generator set can then be stopped by pressing the STOP push button on the GCP.

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The set can now be disconnected

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Appendix A.
Technical Data

Measuring values, voltages ---
Busbar measuring input: front / back switchable
Mains measuring input: front
Front measuring inputs with internal fuse 5x20 mm 5 A slow-to-blow
Rated measuring voltage (V_{rated}) ....230 Vac
Accuracy ....Class 1
Linear measuring range ....$1.3 \times V_{rated}$
Maximum power consumption per path .... < 0.15 W
Input resistance ....approx. 0.7 MΩ

Measuring values, current -------------- **via clamp-on transducer (1mV/1A ac or 10mV/1A ac)**
Voltage signal measuring input for current measurement: front
Rated measuring voltage (V_{measI}) ....1 Vac
Accuracy ....Class 1
Linear measuring range ....1.6 Vac
Input resistance ....approx. 0.21 MΩ

Measuring values, frequency --
Rated measuring frequency (f_N)... 50/60 Hz (40.0 to 70.0 Hz)

Ambient variables --
Power supply (V_{aux}) .... 24 Vdc (18 to 32 Vdc)
Intrinsic consumption ....max. 12 W
Ambient temperature ....-20 to 70 °C
Ambient humidity ....95 %, not condensing

Emergency Stop output---**potential free**
Contact type .... N.O. (make-contact)
Switching voltage .... max. 250 Vac/dc

Interface --**isolated**
Insulation voltage...3,000 Vdc
Version...CAN bus (CAL)

Housing --- **portable with hinged cover**
Type ....Peli 1300 Case Plastic
Dimensions (W × H × D)...approx. 270 mm x 174 mm x 246 mm

Front connector .... safety connectors 4 mm² (isolated)
Back connector .... Industrial connector, A series
(Harting HAN-A, Type 0920 010 2612)
Weight... approx. 3.3 kg

Protection --
Protection system..IP 65
with closed cover and proper installation
Protection system..IP 40
with open cover and proper installation
EMV test (CE) .... tested according to applicable EN guidelines

WOODWARD

Woodward Governor Company
Leonhard-Reglerbau GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (711) 789 54-0 • Fax +49 (711) 789 54-100
sales-stuttgart@woodward.com

Homepage

http://www.woodward.com/power

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